

Two Trichostrongylina (Nematoda) from Venezuela: a new species of *Ornithostrongylus* (Heligmosomoidea), parasitic in birds (Columbiformes) and a new species of *Molineus* (Molineoidea), parasitic in snakes (Squamata)

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ABSTRACT

Description of *Ornithostrongylus volcani* n. sp. (Nematoda, Trichostrongylina, Heligmosomoidea) a parasite of *Zenaidura macroura* (Aves, Columbidae) and *Molineus inexpectatus* n. sp. (Molineoidea) a parasite of *Lachesis mutus* (Squamata, Crotalidae), both from Venezuela. *Ornithostrongylus volcani* n. sp. is closely related to *O. cramae* Vigueras, 1934, a parasite of the same host in Cuba, particularly in the semi-circular shape of the externo-lateral branches of the spicules. It is distinguished from *O. cramae*, mainly by the relative arrangement of rays 2 to 8 of the caudal bursa, and, in the female, by the presence of a vulvar ala. *O. hastatus* (Linstow, 1905), a parasite of Phasianiformes in Europe, having a 2-1-2 pattern of the caudal bursa cannot be classified either in the genus *Ornithostrongylus*, or in the Heligmosomoidea. The lack of information does not allow us to classify it in a particular genus. *O. cramae*, synonymized by Yamaguti (1961) with *O. quadriradiatus* (Stevenson, 1904), a parasite of *Columbia livia* from U.S.A. is considered valid. *Molineus inexpectatus* n. sp. is closely related to *M. mustelae* Schmidt, 1965, a parasite of Mustelidae in the U.S.A. It is mainly differentiated by a smaller number of cuticular ridges, the shape of the spicules and by the presence of cuticular expansions at the level of the excretory pore. The interpretation of the presence of this species in a snake is discussed, the genus *Molineus* being cosmopolitan parasites of Carnivora and neotropical primates.

KEY WORDS

Nematoda,
Trichostrongylina,
Ornithostrongylus volcani n. sp.,
Heligmosomoidea,
Molineus inexpectatus n. sp.,
Molineoidea,
Columbidae,
Crotalidae,
Venezuela.

RÉSUMÉ

Deux *Trichostrongylina* (Nematoda) du Venezuela : une nouvelle espèce d'*Ornithostrongylus* (Heligmosomoidea), parasite d'oiseau (Columbiformes) et une nouvelle espèce de *Molineus* (Molineoidea), parasite de serpent (Squamata).

Ornithostrongylus volcani n. sp. (Nematoda, Trichostrongylina, Heligmosomoidea), parasite de l'intestin grêle de *Zenaidura auriculata* (oiseau, Columbidae) et *Molineus inexpectatus* n. sp. (Nematoda, Trichostrongylina, Molineoidea), parasite de l'intestin grêle de *Lachesis mutus* (serpent, Crotalidae), toutes deux originaires du Venezuela, sont décrites ici. *Ornithostrongylus volcani* n. sp. est morphologiquement proche de *O. cramae* Vigueras, 1934, parasite du même hôte à Cuba, particulièrement par la forme en arc de cercle des branches externo-dorsales des spicules. Il s'en distingue par la disposition relative des côtes bursales 2 à 8 et, chez la femelle, par la présence d'une aile vulvaire. *O. hastatus* (Linstow, 1905), parasite de Phasianiformes en Europe, ne peut être classée ni dans le genre *Ornithostrongylus*, ni dans les Heligmosomoidea, sa bourse caudale étant de type 2-1-2 mais le manque d'autres éléments descriptifs ne permet pas de la classer dans un genre déterminé. *O. cramae*, synonymisée par Yamaguti (1961) avec *O. quadriradiatus* (Stevenson, 1904) parasite de *Columbia livia* aux U.S.A., est revalidée. *Molineus inexpectatus* n. sp., morphologiquement proche de *M. mustelae* Schmidt, 1965, parasite de Mustelidae aux U.S.A., s'en distingue par un nombre inférieur de crêtes cuticulaires, par la forme de ses spicules et par la présence d'expansions cuticulaires au niveau du pore excréteur. L'interprétation de la présence de cette espèce chez un serpent est discutée, les espèces du genre *Molineus* étant des parasites cosmopolites de carnivores et de primates néotropicaux.

MOTS CLÉS

Nematoda,
Trichostrongylina,
Ornithostrongylus volcani n. sp.,
Heligmosomoidea,
Molineus inexpectatus n. sp.,
Molineoidea,
Columbidae,
Crotalidae,
Venezuela.

INTRODUCTION

Neotropical Trichostrongylina are known primarily from mammals. Nematodes collected in Venezuela allowed us to describe two new species: the first, which belongs to the genus *Ornithostrongylus* (Ornithostrongylidae), is described from a Columbidae, the usual host of the genus. The second, which belongs to the genus *Molineus* (Molineidae), is described in a snake. Hitherto, the genus is only known from Carnivora throughout the world and from neotropical primates.

MATERIAL AND METHODS

Nematodes were collected from the intestine of their hosts, fixed in boiling 70% ethanol and stored in this fixative. The nomenclature of the Strongylida above the family group follows that of Durette-Desset & Chabaud (1993). The

nomenclature used to describe the caudal bursa is that of Durette-Desset & Chabaud (1981a). The synopse was studied according to the method developed by Durette-Desset (1985). Measurements are in micrometers except where stated otherwise. Specimens are deposited in the parasitological collections of the Museo de Biología, Universidad Central de Venezuela (CP-MBUCV) and in the helminthological collections of the Muséum national d'Histoire naturelle de Paris (MNHN).

SYSTEMATICS

Genus *Ornithostrongylus* Travassos, 1914

Ornithostrongylus volcani n. sp.
(Figs 1; 2)

TYPE MATERIAL. — Holotype male, allotype female (MNHN 136 KK), 5 ♂♂, 3 ♀♀, paratypes (CP-MBUCV n° 4591).

ETYMOLOGY. — After the name of the collector.

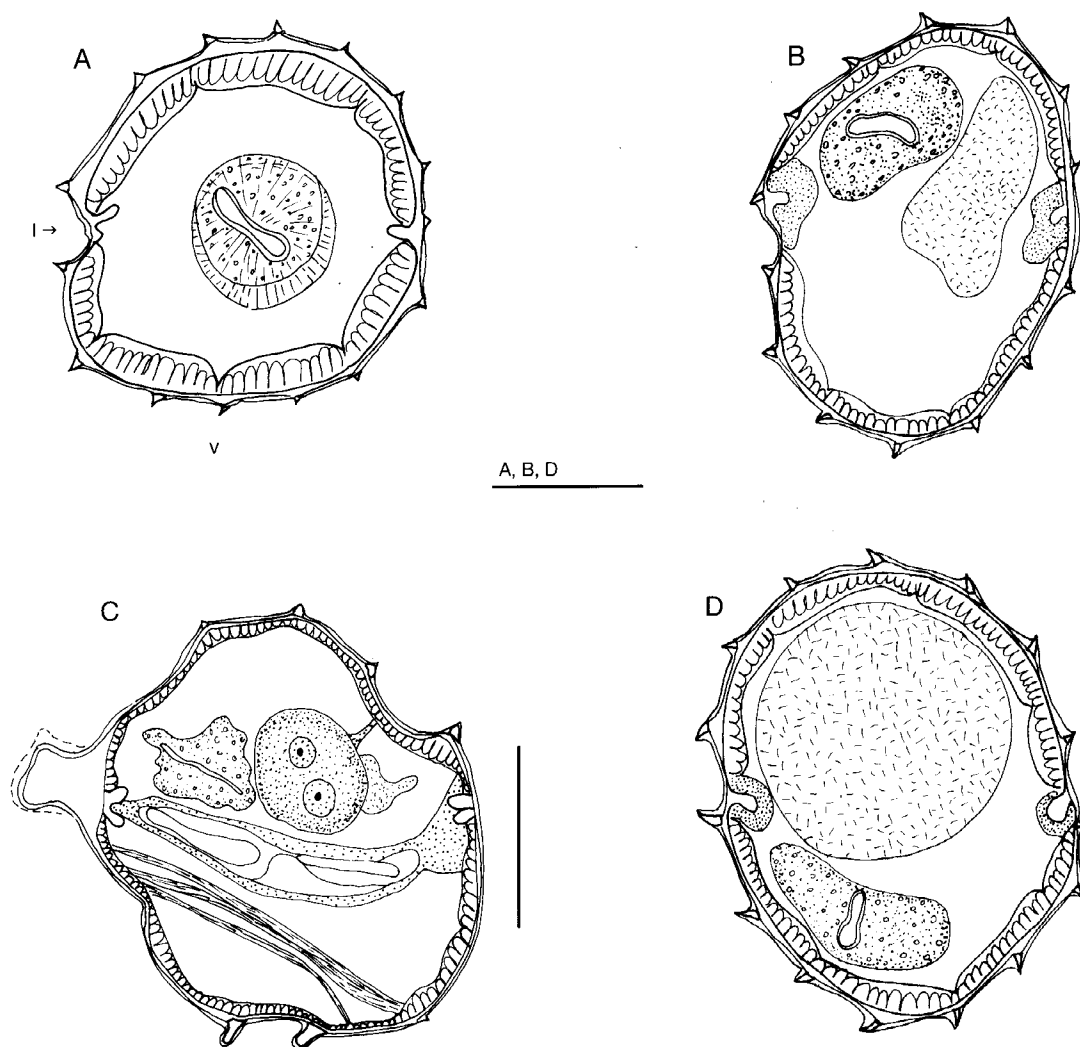


FIG. 1. — *Ornithostrongylus volcani* n. sp. from *Zenaidura auriculata*. Transverse sections of the body; A-C, female; A, at the level of the oesophago-intestinal junction; B, at mid-body; C, at the level of the vulvar ala; D, male, at mid-body. Abbreviations: l, left side; v, ventral side. All the sections of the body are orientated as A. Scale bars: A, B, D, 30 µm; C, 50 µm.

GEOGRAPHICAL ORIGIN. — Ciudad Bolivar, Edo. Bolivar, Venezuela, III.1985, R. Volcan coll.

HOST. — *Zenaidura auriculata* (Des Murs, 1847) (Columbidae).

SITE. — Small intestine.

DESCRIPTION

Nematodes not coiled, with female being nearly three times as long as male. Deirids situated in posterior part of oesophagus at about same level

as excretory pore (anterior to, exactly at same level as, or posterior to) (Fig. 2A, B).

Head

Cephalic vesicle and small buccal capsule present. In apical view, rounded mouth with small oesophageal tooth, six externo labial papillae present of which latero labial have shared peduncle with amphids and four cephalic papillae (Fig. 2C).

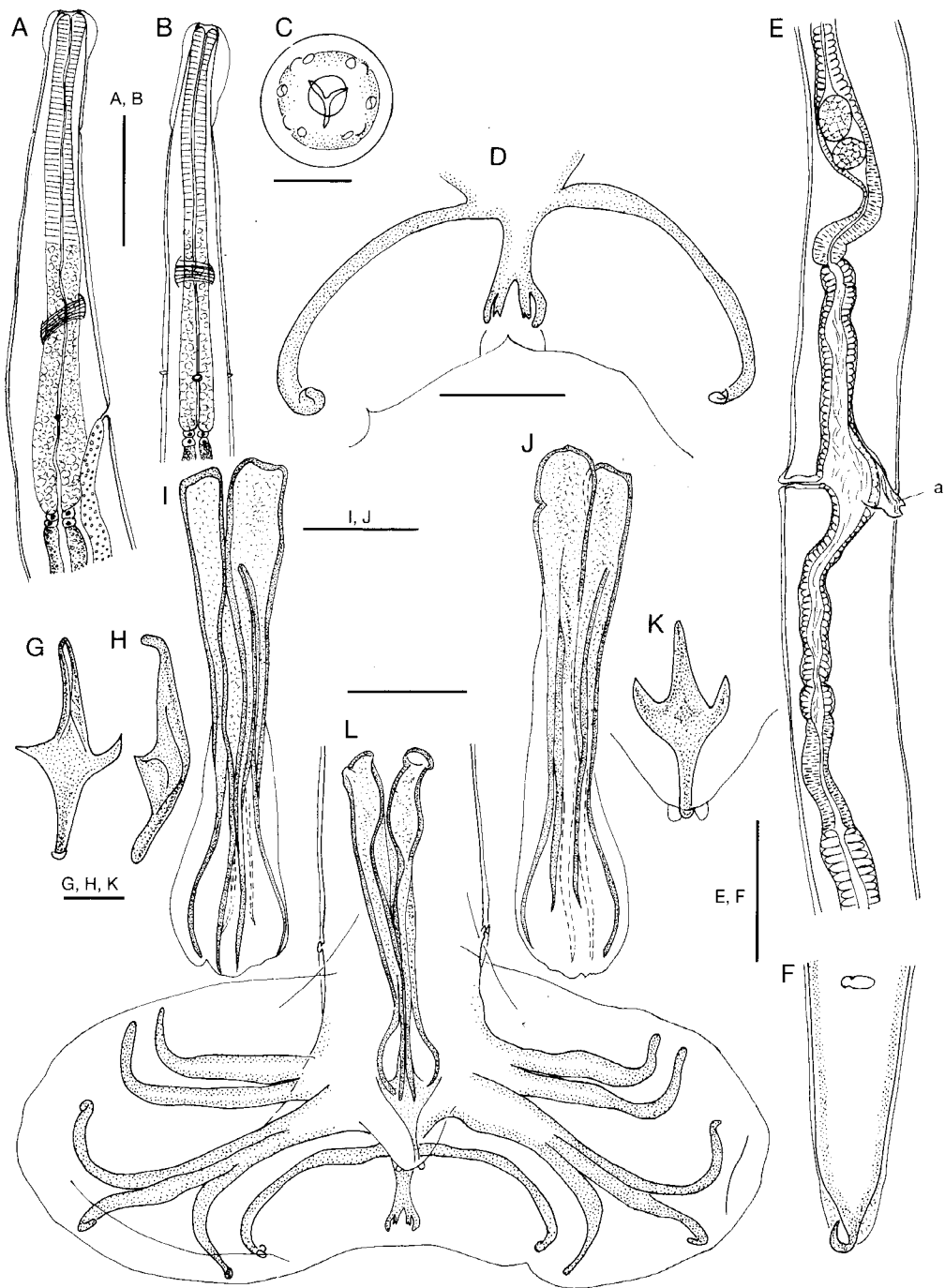


FIG. 2. — *Ornithostrongylus volcani* n. sp. from *Zenaidura auriculata*: **A**, female, anterior extremity, right lateral view; **B**, male, anterior extremity, ventral view; **C**, male, head, apical view; **D**, male, rays 8 and dorsal ray, dorsal view; **E**, female, ovejector, left lateral view; **F**, female, tail, ventral view; **G**, **H**, male, gubernaculum dissected, ventral and left lateral views; **I**, **J**, spicules not dissected, ventral and dorsal views; **K**, other male, gubernaculum and genital cone with papillae 7, ventral view; **L**, male, caudal bursa, ventral view. Abbreviation: **a**, ala. Scale bars: A, B, 100 µm; C, 10 µm; D, 40 µm; E, F, 50 µm; G, H, K, 20 µm; I, J, 30 µm; L, 75 µm.

Synlophe

Studied in one male and one female, paratypes. In both sexes, cuticle bears longitudinal, uninterrupted ridges. They appear at about 10 posterior to cephalic vesicle and disappear anterior to caudal bursa in male and at about 1500 anterior to caudal extremity in female. In cross section at mid-body, there are 15 ridges (seven dorsal, eight ventral) (Fig. 1B, D). No ridges opposite lateral cords except at level of oesophagus (Fig. 1A). Double gradient present, the size of which slightly decreases from left to right on both sides. Axis of orientation of ridges frontal, directed from right to left (Fig. 1). In female, small left lateral cuticular flap at level of vulva observed (about 50-80 long and 25-35 wide in distal part according to the specimens) (Figs 1C; 2E).

Holotype male

5.6 mm long, width increasing regularly from 55 at level of oesophago-intestinal junction to 90 in front of caudal bursa; cephalic vesicle 70 long by 30 wide; nerve ring, excretory pore and deirids 150, 230 and 240 from apex, respectively; oesophagus 290 long (Fig. 2B).

Symmetrical caudal bursa with pattern of type 2-2-1 (Fig. 2L). Small prebursal papillae observed only in some specimens. Rays 2 and 3 whose with extremities remote from each other, not joined, parallel. Rays 4 and 5 curved, divergent extremities. Distance between extremities of rays 5 and 6 greater than between extremities of rays 6 and 8. Rays 8 in an arc, arising at root of dorsal ray with extremities curved on internal side. Thick, short dorsal ray divided at its distal third into two branches, each branch divided into two branches, external ones (rays 9) longer than internal ones (rays 10) (Fig. 2D).

Spicules 165 long, with handle divided into three terminal, pointed branches of unequal length. Interno-dorsal branch longest, interno-ventral shortest. Externo-lateral branch slightly curved on internal side like an arc. Branches enclosed with a membrane (Fig. 2I, J). In median view, cross-shaped gubernaculum, 70 long (Fig. 2G, H, K), and 35 maximum width. Lateral branches of gubernaculum most frequently directed forwards (Fig. 2K). In lateral view, proximal part of gubernaculum curved ventrally (Fig. 2H). Well-

developed genital cone with rounded papillae 7 on dorsal lip (Fig. 2K). Papilla zero not observed. Averages, minima and maxima of the main measurements of the five paratypes: length, 5.7 (4.2-7.2); width, 59 (54-60) at level of oesophago-intestinal junction to 83 (80-90) in front of caudal bursa; cephalic vesicle 74.6 long (70-85) by 34 wide (30-35); nerve ring 154 (140-170), excretory pore 225 (180-250) and deirids 226 (215-260) from apex, respectively; oesophagus 324 (255-370); spicules 164 (155-170); gubernaculum in median view 66 (55-75) × 31 (30-35).

Allotype female

13.1 long, width 120 increasing regularly from 70 at level of oesophago-intestinal junction to 140 at mid-body. Cephalic vesicle 90 long by 40 wide; nerve ring, excretory pore and deirids 190, 240 and 235 from apex, respectively; oesophagus 380 long (Fig. 2A).

Didelphic: vulva 3.3 mm from caudal extremity. *Vagina vera* 40 long, dividing vestibule, 470 long, into two equivalent parts. Anterior sphincter 35 long by 45 wide, anterior infundibulum 160 long. Posterior sphincter 40 long by 45 wide, posterior infundibulum 155 long (Fig. 2E). Anterior uterine branch 3.5 mm long with >100 eggs in morula stage, 45 long by 30 wide, on average. Posterior uterine branch 1.9 mm long with 74 eggs. Tail 113 long, slightly refringent at its extremity, with caudal spine 20 long (Fig. 2F). Vulvar ala 75 long by 25 wide at its distal part.

Averages, minima and maxima of the main measurements of the three paratypes: length 15.6 (14.1, 16, 4); width 58 (50-65) at level of oesophago-intestinal junction to 137 (130-140) in front of vulva; cephalic vesicle 85 (75-95) long by 34 (30-38) wide; nerve ring 197 (165-230), excretory pore 252 (205-300) and deirids 263 (205-325) from apex, respectively; oesophagus 342 (305-380). Vulva at 3.6 (3.4-3.7) mm from caudal extremity. *Vagina vera* 43 (40-45) long, vestibule 450 (410-500) long. Anterior sphincter 31 (30-33) long by 39 (37-40) wide, anterior infundibulum 143 (140-150) long. Posterior sphincter 33 (32-34) long by 39 (38-40) wide, posterior infundibulum 148 (140-155) long (Fig. 2E). Anterior uterine branch 2.9 (2.2-3.4) mm long, with 58 (10-100) eggs, 45

(43-50) long by 30 (22-38) wide, on average. Posterior uterine branch 1.7 (1.4-2.0) mm long with 17 (0-30) eggs. Tail 116 (110-125) long, slightly refringent in its extremity, with caudal spine 20 (20-20) long (Fig. 2F). Vulvar ala 75 (50-80) long by 25 (25-25) wide at its distal part.

DISCUSSION

The above specimens show the main characteristics of the genus *Ornithostrongylus* Travassos, 1914, a cosmopolitan parasite of birds, and mainly Columbiformes. Of the 13 known species, *O. almeidai* Travassos, 1937 is a parasite of Tinamidae from Brazil. *O. hastatus* (Linstow, 1905), a parasite of Phasianiformes from Europe, cannot be classified in the Heligmosomoidea, the pattern of the caudal bursa being of type 2-1-2. The other morphological characters are not sufficiently described in order to classify the species. *Ornithostrongylus* is characterized mainly by its synlophe which has a sub-frontal axis of orientation, the pattern of the caudal bursa of type 2-2-1 and a didelphic female. The species most closely related to the specimens from Venezuela seems to be *O. cramae* Vigueras, 1934, a parasite of *Zenaidura macroura* (Linné, 1758) and *Z. auriculata* from Cuba (Barus, 1969). Although no description of the synlophe or of the genital apparatus of the female was given, the two species are the only ones having spicules in which the externo-lateral branches form an arc. In addition, some features of the caudal bursa are similar: rays 2 and 3 not joined along their length; rays 8 almost reaching the edge of the caudal bursa; dorsal ray divided half way down; rays 9 arising after the division of the dorsal ray; cross-shaped gubernaculum. The species from Venezuela is distinguished by the following features: 1) rays 6 arising from the common trunk of the lateral trident before the divergence of rays 4 and 5 (at the same level in *O. cramae*); 2) distance between the extremities of rays 6 and 8 smaller than that of the extremities of rays 6 and 5; 3) rays 8 arising perpendicularly from the dorsal ray; 4) dorsal ray divided at distal third. In addition, in the specimens from Venezuela, the female has a vulvar ala.

The species parasitic in *Zenaidura auriculata* therefore belongs to a new species that we have named *Ornithostrongylus volcani* n. sp.

O. cramae has been placed in synonymy with *O. quadriradiatus* (Stevenson, 1904), a parasite of *Columbia livia domestica* (Linné, 1758) from U.S.A. by Yamaguti (1961). Anderson (1992) admitted this synonymy. By contrast, we believe that *O. cramae* is a valid species. In *O. quadriradiatus*, rays 8 are short and terminate further from the edge of the caudal bursa than rays 6; the dorsal ray is divided at its apex; rays 9 are of equivalent length as rays 10; the spicules are divided into three branches at their distal extremities and their externo-lateral branches do not form an arc.

Irwin-Smith (1920) identified as *O. quadriradiatus* some specimens from the domestic pigeon but found in Australia. She created the genus *Cephalostrongylus* Irwin-Smith, 1920 for the species of Stevenson (1904). Travassos (1937) placed *Cephalostrongylus* in synonymy with *Ornithostrongylus*. The description and the illustrations of Irwin-Smith (1920) allow us to confirm that the Australian specimens can be identified as Stevenson's (1904) *quadriradiatus*.

Travassos (1937) also gave some drawings of *O. quadriradiatus* but with no indication of the host or the biogeographic origin of the parasites. This material cannot be identified with the original material of Stevenson (1904), particularly in the shape of the spicules and the relative disposition of the bursal rays. In addition, the host and the biogeographic region of these specimens being unknown, it will never be possible to name them. *O. quadriradiatus* has been reported from all over the world in *Columba livia domestica*. This cosmopolitan distribution should be verified as *O. quadriradiatus* and *O. cramae* have been confused since 1961.

Genus *Molineus* Cameron, 1923

Molineus inexpectatus n. sp. (Fig. 3)

TYPE MATERIAL. — Holotype male, allotype female (MNHN 135 KKa); 2 ♂♂, 2 ♀♀, paratypes (MNHN 135 KKb).

ETYMOLOGY. — In reference to the unexpected host where it was found.

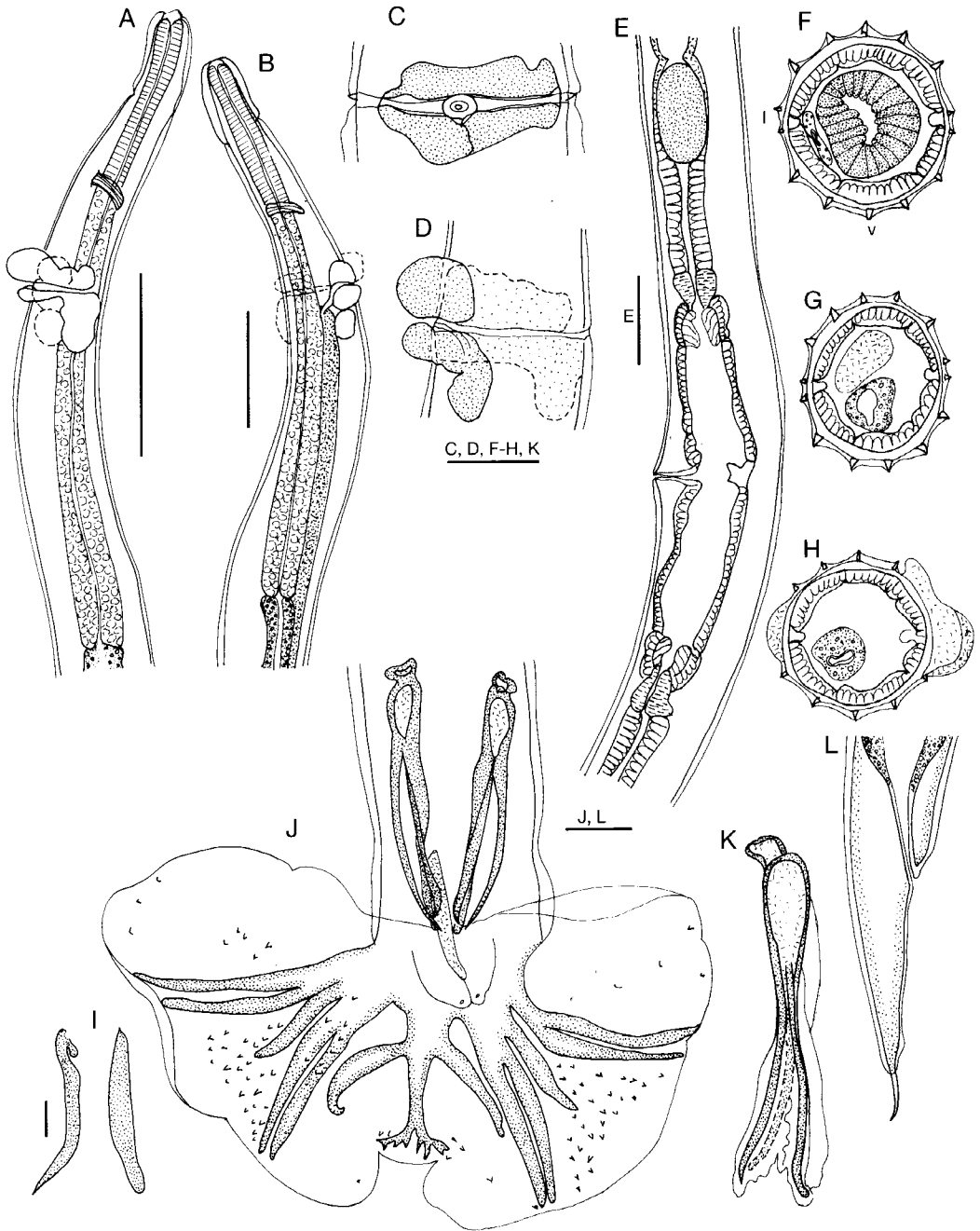


FIG. 3. — *Molineus inexpectatus* n. sp. from *Lachesis muta*; **A**, female, anterior extremity, ventral view; **B**, *idem*, right lateral view; **C**, other female, detail of the cuticular expansions at the excretory pore level, ventral view; **D**, *idem*, left lateral view; **E**, female, ovjector, left lateral view; **F-H**, transverse sections of the body; **F**, male, at mid-body; **G**, female, *idem*; **H**, female, at level of cuticular expansions; **I**, gubernaculum, left lateral and ventral views, respectively; **J**, male, caudal bursa, ventral view; **K**, male, dissected right spicule, ventral view; **L**, female, tail, right lateral view. Abbreviations: l, left side; v, ventral side. All the sections of the body are orientated as **F**. Scale bars: **A**, 100 μ m; **B**, 75 μ m; **C**, **D**, **F-H**, **K**, 30 μ m; **E**, 50 μ m; **I**, 10 μ m; **J**, **L**, 25 μ m.

GEOGRAPHICAL ORIGIN. — Parque Yapacana, Edo. Amazonas, Venezuela, 1981.

HOST. — *Lachesis muta* Linné, 1766 (Crotalidae).

SITE. — Intestine.

DESCRIPTION

Small nematodes, not coiled. Excretory pore situated in anterior part of oesophagus, at bottom of circular excretory furrow, surrounded by cuticular expansions of irregular shape and in variable number according to specimens (Fig. 3A-D). Deirids unobserved, probably because they are situated at bottom of furrow.

Synlophe

Studied in one male and one female, paratypes. In both sexes, cuticle bears uninterrupted ridges which appear posterior to cephalic vesicle and disappear just anterior to caudal bursa in male and at about 135 anterior to caudal extremity in female.

In cross section, at mid-body, there are 14 ridges: five dorsal, five ventral and four lateral (two right and two left) (Fig. 3F, G). At level of cuticular expansions, no lateral ridges (Fig. 3H). Ridges regularly spaced except those opposite the lateral field which are close to one another and slightly smaller than other ridges. Ridges orientated perpendicularly to body surface.

Holotype male

3.4 mm long and 45 wide at mid-body; cephalic vesicle 60 long by 40 wide; nerve ring and excretory pore 140 and 186 from apex, respectively; oesophagus 335 long.

Symmetrical caudal bursa with pattern of type 2-1-2, with spiny projections on lateral lobes mainly between rays 3 and 5. Rays 4 very short, extremities nearer those of rays 5 than those of rays 3. Rays 8 arising from dorsal ray, shorter than the latter. Dorsal ray divided into two branches at its distal extremity, each one giving rise to three small branches (rays 9, 10 and 11), external branches (rays 9) being subdivided at their extremity into two small branches (Fig. 3J). Spicules narrow, alate, 99 long, divided distally into three branches (Fig. 3K). Gubernaculum rectangular in shape, 50 long in ventral view (Fig. 3I).

Main measurements of the two paratype males: 3.3, 3.5 mm long and 50, 50 wide at mid-body; cephalic vesicle 50, 50 long by 50, 45 wide; nerve ring and excretory pore 130, 150 and 180, 180 from apex, respectively; oesophagus 330, 345 long. Spicules 95, 95 long and gubernaculum 50, 55 long in ventral view.

Allotype female

4.2 mm long and 60 wide at mid-body, cephalic vesicle 77 long by 34 wide; nerve ring and excretory pore 110 and 170 from apex, respectively; oesophagus 350 long (Fig. 3A, B).

Didelphic: vulva at 680 from caudal extremity, in posterior seventh of body. *Vagina vera* 23 long dividing vestibule, 164 long, into two parts, anterior branch being slightly longer. Anterior sphincter and infundibulum 28 and 29 long, respectively. Posterior sphincter and infundibulum 25 and 22 long, respectively (Fig. 3E). Anterior uterine branch 855 long with six eggs. Posterior uterine branch 815 long with six eggs. Eggs in morula stage 53 long by 30 wide. Tail 110 long with ventral bulge and caudal spine 20 long (Fig. 3L).

Main measurements of the two paratype females: 5.8, 6.3 mm long and 60, 60 wide at mid-body, cephalic vesicle 67, 70 long by 34, 34 wide; nerve ring and excretory pore 100, 90 and 125, 140 from apex, respectively; oesophagus 250, 310 long.

Didelphic: vulva at 675, 700 from caudal extremity, in posterior seventh of body. *Vagina vera* 24, 25 long; vestibule 150, 160 long. Anterior sphincter and infundibulum 25, 25 and 28, 30 long, respectively. Posterior sphincter and infundibulum 20, 25 and 28, 30 long, respectively. Anterior uterine branch 750, 795 long with 4-1 eggs. Posterior uterine branch 720, 750 long with 4-0 eggs. Eggs in morula stage, 50-54 long by 40-35 wide. Tail 80, 120 long with ventral bulge and caudal spine 20, 20 long.

DISCUSSION

The specimens from the snake belong to the genus *Molineus* Cameron, 1923 (Molineoidea)

whose main features are as follows: a bilaterally symmetrical synlophe with the cuticular ridges orientated perpendicularly to the body surface; a caudal bursa with a pattern of type 2-1-2 and very short rays 4; the extremities of rays 4 situated almost at mid-distance between those of rays 3 and rays 5; the female with a very short infundibulum. Among the 41 species described in this genus, only four species have both of the two following features in common with our specimens: 1) rays 4, whose extremities are slightly closer to those of rays 5 than to rays 3; 2) three-branched spicules of equal size. The species are *M. cynictis* Troncy, 1970, a parasite of Canidae in Chad (Africa), *M. felineus* Cameron, 1923, a parasite of Felidae in South America, *M. paraensis* Travassos, 1937, a parasite of Procyonidae in Brazil and *M. mustelae* Schmidt, 1965, a parasite of Mustelidae in the U.S.A.

The first three species are distinguished from our specimens by rays 4 which are less than half the length of rays 5, while they are longer in the specimens described above. *M. mustelae* seems to be the closest species, particularly in its bursal features with the dorsal ray divided into eight branchlets instead of six, the relative length of rays 4 as related to rays 5, the similar anatomy of the spicules and also the presence of an excretory furrow.

Our specimens are distinguished by a slightly smaller number of cuticular ridges, by the shape of the spicular tips, by the absence of a proximal hook on the gubernaculum, and by the presence of cuticular expansions at the level of the excretory pore.

We consider the specimens from the snake as a new species, *Molineus inexpectatus* n. sp. The presence of this worm in a snake is difficult to interpret because according to Durette-Desset & Chabaud (1981b), the genus *Molineus* parasitizes only Carnivora all over the world and the neotropical primates. It is highly improbable that the snake ate a carnivore since the diet of this snake mainly consists of spiny rats, *Proechimys* Allen, 1899. If this were the case, it would be possible to interpret the occurrence as an accidental phenomenon. Durette-Desset *et al.* (1994) pointed out that, in the Tricho-

strongylina, capture of parasites is more frequent than coevolution. Whether *Molineus* exhibit oral transmission or skin penetration, the New World monkeys captured *Molineus* from carnivores. Consequently, larvae must be available to monkeys either in the tree or at their base, which are also the usual habitats of the crotalid snake *Lachesis muta*.

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